

# Biota of a Temperate Shallow Water Reef

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This study describes the total flora and fauna of a small (1 m<sup>2</sup>) but representative area of temperate water reef 23 m deep near Sydney, New South Wales. Excluding Foraminifera, the biota totalled 150 species comprising 29 algal, 120 invertebrate and 1 fish species. Hydroids are dominant in terms of species (13%) and sessile invertebrates comprise 51% of community biomass and 61% of species. Algae comprise 19% of species and 36% of community biomass. Populations of numerable animals are dominated by polychaetes (18%) and amphipods (17%). The sample yielded 8 new species, one new genus, extended the Australian provincial distribution of 17 species and provided 4 new records for Australia.

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## INTRODUCTION

In recent years there have been a number of studies on the species composition, distribution and ecology of the soft bottom littoral and sublittoral estuarine communities of the south-eastern Australian coastline (King *et al.*, 1971; Stephenson *et al.*, 1974; Poore & Rainer, 1974; Hutchings & Recher, 1974). There are however, few published reports upon the epibiota of sublittoral reefs. These include several detailed studies of the ecology of benthic Algae in South Australian waters by Shepherd and Womersley (1970, 1971, 1976), and generalized accounts of the benthic ecology of Gulf St. Vincent and Investigator Strait in South Australia (Shepherd & Sprigg, 1976; Richardson & Watson, 1975a, 1975b), of Westernport Bay in Victoria (Smith *et al.*, 1975), and of the central New South Wales coast near Sydney (Laxton, 1976, 1977; Jones, 1977). None of these studies has, however, been directed towards a complete analysis of the epibiota at any one sampling site.

As part of a wider survey involving pollution studies at other localities on the central New South Wales coastline, the biota of a flat-topped sandstone reef in an unpolluted environment at 23 m depth was sampled at a site 500 m east of Jibbon Bombora in the ocean off Port Hacking (34° 01' 20" S., 151° 14' 20" E.) in September 1976.

## SAMPLING METHODS

Following preliminary inspection, a site representative of the biota of the reef top was selected for sampling. A hoop of 0.33 m<sup>2</sup> was then thrown randomly on the site and the enclosed biota completely scraped into a fine mesh bag. This was repeated to give a total sampling area of 1 m<sup>2</sup>.

The samples were later sorted under the microscope to species level and individual organisms counted. Colonial organisms were drained, blotted, and estimated as damp weight. This method of estimation of biomass was adopted since damp weighing does not destroy specimens which may later require detailed taxonomic examination.

Only Foraminifera were not examined in detail.

## RESULTS

The list of species, together with numbers of individuals animals and the biomass of larger colonial organisms is given in the Appendix. Smaller colonial organisms are assigned a rank order of abundance from 1 (rare); 2 (common), to 3 (abundant).

The biota of the total sampling area of 1 m<sup>2</sup> comprises 150 species, of which 29 (19%) are Algae belonging to 29 genera. One hundred and twenty species are invertebrates, referable to at least 100 genera (not including sponges), and there is 1 species of fish. In terms of numbers of species, hydroids are the most abundant invertebrate group with 19 species (13% of total invertebrate species present), followed by Bryozoa (15 species, 10%), polychaetes (15 species, 10%), amphipods (12 species, 8%), sponges (11 species, 7%), bivalves (10 species, 7%), and gastropods (8 species 5%). The collection contains 155 individual non-colonial animals with the polychaetes contributing the greatest number (28 individuals, 18%), followed by amphipods (27 individuals, 17%), gastropods (26 individuals, 17%), bivalves (25 individuals, 16%), and ophiuroids (17 individuals, 11%).

The colonial polychaetes *Phyllochaetopterus socialis*, *Serpula vermicularis* and *Filograna implexa*, with relative abundances of (3), (2) and (1) respectively, would, if counted as individuals, considerably augment the polychaete population.

Total biomass of Algae and animals amounts to some 700 g damp weight. In terms of biomass, the sponges, with 283 g (40% of biomass) are the most abundant group, followed by Algae with 255 g (36% of biomass), and the single alcyonarian colony, *Capnella gaboensis*, with 36 g (5% of biomass). The remaining biomass is made up of gastropods (3%), one species of ascidian, *Polycarpa pedata* (3%), bivalves and Bryozoa (each 2%), and hydroids (1%).

The more important groups of the biota are discussed below:

*Algae*

Of the 29 algal species recorded, 26 are red Algae and the remainder brown. All are small, low growing, turf-like species. Three are new records for New South Wales and include *Antithamnion pinnafolium* Wollaston, previously unknown outside South Australia, *Anotrichum crinitum* (Kuetzing) Baldock, which has a recorded distribution of southern Australia and New Zealand, and *Schottera nicaeense* (Duby) Guiry and Hollenberg, a Mediterranean species. Two as yet undescribed species, *Propagula* sp., and *Mediothamnion* sp., only recently discovered in Port Phillip Bay, Victoria, were also present in the sample. Several other species may also represent new taxa, but the material is insufficient for determination.

*Sponges*

This group comprises 11 species in 4 families. Only one, *Callyspongia* sp., a small grey dish-shaped sponge, could be identified to genus. The next most abundant sponge is an erect orange-coloured species belonging to the Raspailiidae. All are common sponges along this part of the New South Wales coastline.

*Hydroids*

The shallow water hydroid fauna of the New South Wales coast is known only from records of Bale (1884, 1888) and from the reports of the "Thetis" Expedition (Ritchie, 1911) and occasional incidental references in the literature. The 19 species of hydroids in the collection include 2 undescribed species, one belonging to the genus *Hebella*, and the other to *Antennella*. There are also 6 new records for the central east coast of Australia. Several of the newly recorded species are abundant in the sample and include the large plumose hydroid, *Plumularia asymmetrica* Bale, formerly recorded from the Great Australian Bight (Bale, 1915; Watson, 1973); *Scoresbia daidala* Watson, a small, obligatory epiphyte on the brown alga *Zonaria crenata* J.

Agardh, recorded once previously from the type locality in Gulf St. Vincent, South Australia, *Monostaechus quadridens* McCrady, formerly recorded from Queensland (Pennycuik, 1959), and *Sertularia olseni* Watson, a hydroid associated with sponges, recorded once, from the type locality in the Great Australian Bight (Watson, 1973).

Only 2 of the hydroids, *Tubularia australis* Stechow, and *Eudendrium* sp., are athecate species. Of the 17 thecate species, 13 are small epiphytes growing among the algal turf, and the remainder, with the exception of the epilithic *Plumularia asymmetrica*, are epizooites, growing upon tubicolous polychaetes or 'on other hydroids.

#### *Alcyonaria*

This group is represented by 3 species, including one large colony of *Capnella gaboensis* Verseveldt. Although only recently described (Verseveldt, 1977), this is a common shallow water alcyonarian of New South Wales coastal reefs.

#### *Bryozoa*

The bryozoan fauna of the New South Wales coastline is not well known, and of the 12 species represented in the sample, 5 are new records for this part of the Australian coastline. There are 7 species of crustose (membraniporiform) Bryozoa, 4 erect jointed (cellariiform) species and 1 erect (vinculariiform) species. The cellariiform species, *Crisia acropora* Busk and *Emma triangula* Hastings, are among the new locality records and are also the most abundant species in the sample. *C. acropora* is known from Bass Strait (Busk, 1875) and *E. triangula* is known from this locality as well as from New Zealand (Hastings, 1939).

#### *Polychaetes*

Of the 15 species of polychaetes present, tubicolous forms are the dominant group in terms of numbers and include 5 species of serpulids. *Phyllochaetopterus socialis* Claparède is the most abundant polychaete in the sample (abundance (3) ), the clustered tubes providing substrate for a number of small sessile species, including hydroids and Bryozoa. The cosmopolitan *Nematonereis unicornis* Grube is recorded for the first time in Australian waters. The nearest locality record for this species is the Indo-west Pacific.

Approximately half of the polychaete species and the major part of the polychaete population are filter feeders, including all of the tubicolous species. The remainder may be either omnivores or predators but there is little information on their feeding habits.

#### *Mollusca*

The shelled molluscs are all small reef dwelling species well known from the literature. The sample comprises 26 gastropods belonging to 8 species and 25 individuals of 10 bivalve species.

The predatory boring gastropod, *Torvamurex denudatus* (Perry) is the most abundant mollusc with 11 individuals in the sample. Since few bored bivalve shells were found, it seems likely that this species may be an unspecific predator or scavenger.

The algal browsing seahare, *Aplysia sydneyensis* Sowerby, is represented by one specimen. The type locality of this circumglobal species is Port Jackson. The remaining 2 species of opisthobranchs are undescribed species of the genera *Philine* and *Trapania*, the latter being a first record of this cosmopolitan genus for Australia.

#### *Amphipoda*

There are 2 undoubted, and possibly 5 additional undescribed species, reflecting the poor state of knowledge of the taxonomy of the group. *Mallacoota subcarinata*

(Haswell), commonly occurring throughout south-eastern Australia, is the only species whose distribution is known. Half of the 11 amphipod species and the tanaid *Paratanais* cf. *ignotis* (Chilton) are tubiculous forms which are usually responsible for stabilization of substrate, accumulating silt and detritus in and around their tubes.

#### *Isopoda*

Of the 3 species of isopods recorded, only one, *Cymodoce aspersa* (Haswell), whose type locality is Port Jackson, has been fully described. A single juvenile female is probably *Cilicæopsis granulata* (Whitelegge). Jibbon Head, adjacent to the sampling site, is one of the localities where this species was collected by Whitelegge (1902). The third species, represented in the sample by 2 adult males is an undescribed species which may also be worthy of separate generic status (W. Seed, pers. comm.). A similar, unnamed specimen was recorded from Masthead Island on the Great Barrier Reef by Baker (1926).

#### *Ophiuroidea*

The 4 species of ophiuroids include one new genus and one new record for the Australian east coast. The undescribed genus is an amphiuroid related to the cosmopolitan shallow water species *Amphipholis squamata* (Delle Chiaje) (A. Baker, pers. comm.), and the new record is *Ophiacantha alternata* A. M. Clark, a small sublittoral form previously known from Port Phillip Bay, Victoria. The 2 other species, *Ophioactis resiliens* Lyman and *Ophiothrix caespitosa* Lyman are common components of the immediate sublittoral algal-sponge-bryozoan fauna of temperate Australia.

#### *Holothuroidea*

Of the 3 species identified, *Pentacta australis* Ludwig is a common form widely distributed along the Australian coastline. The other two species comprise *Neocucumis* ? *watasei* (Oshima), known only from Japan, and an undescribed species of *Thyone*.

#### *Other Species*

The brachiopod *Magellania flavescens* (Lamarck) represented by one small specimen, is a widely, but sparsely distributed species in shallow ocean waters of temperate Australia. *Balanus trigonus* (Darwin) is one of the commonest barnacles of the sublittoral of the New South Wales coastline, where it has been dredged from depths of up to 108 m (Pope, 1945). The ascidian *Polycarpa pedata* Herdman, is a very common solitary ascidian of the sublittoral of the south-eastern coast. It frequently grows in association with the stalked ascidian, *Pyura spinifera* (Quoy & Gaimard) (J. E. W. unpub.).

### DISCUSSION

The 150 species belonging to 104 genera include a new genus of ophiuroid and a probable new genus of isopod. Eight are probable new species (2 hydroids, 2 opisthobranchs, 2 amphipods, 1 isopod and 1 holothurian). The ranges of 4 algal species, 6 hydroids, 5 bryozoans and 1 ophiuroid are extended to the temperate east coast from the cool temperate southern region and the range of one isopod species is extended southwards from the Great Barrier Reef. There are 4 new records for Australia with the discovery of the cosmopolitan polychaete *Nematonereis unicornis*, the holothurian *Neocucumis* ? *watasei*, previously recorded from Japan, the opisthobranch, *Trapania* sp., and the Mediterranean red alga, *Schottera nicaeense*. This number of new species and new records is all the more remarkable when the small size of the sampling area, and its situation in a region considered to be relatively well known scientifically, is taken into account.

With the exception of *Callyspongia*, the larger of which was 10 cm in diameter, and the ascidian *Polycarpa pedata*, the biota comprised small to very small organisms, most of which are dependent upon the algal turf for substrate, food and shelter. The algal community is dominated by small filamentous rhodophytic species; there are only 3 small species of brown Algae, and green Algae are absent.

Sessile invertebrates comprise 51% of the biomass of the community and 61% of the species present. Algae account for 36% of the biomass and 19% of the species; algal cover was subjectively estimated at 50% of the sampling area.

Analysis of community trophic structure shows that the greatest contribution to the animal community biomass (48%) is by the suspension feeding component, dominated by sponges. In terms of species, however, carnivores, mainly microcarnivores, comprise the largest single feeding class with 42% of the total species present. Using photographic techniques in benthic studies off the New South Wales coastline, Laxton (1976, 1977) and Jones (1977), found that microcarnivores contributed the greatest percentage cover on most rocky substrates in areas where water turbidity is high. Pequengnat (1964), using species and population counts, found that suspension feeders were the most abundant components of a Californian reef-top habitat. Analysis of the present very limited sample supports Laxton's findings; it is quite likely however, that habitat or geographical differences as well as sampling methods may lead to widely varying results.

The new locality records from this sample provide further information upon the biogeographic affinities of south-eastern Australia with the Indo-Pacific and Japan. The sample also provides additional evidence for the close relationship of the Australian Peronian with the southern Flindersian Province west of Bass Strait.

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## APPENDIX

## LIST OF SPECIES

Numbers after the species name represent individual organisms.

Numbers in parentheses are an estimation of rank order of abundance of colonial organisms and algae, (1) = rare, (2) = common, (3) = abundant.

New records are marked \*.

Probable new genera or new species are marked\*.

## ALGAE

## Phaeophyta:

- Halopteris platycena* Sauvageau (2)  
*Dictyota alternifida* J. Agardh (2)  
*Zonaria sinclairii* Hooker & Harvey (3)

## Rhodophyta:

- Delisea fimbriata* (Lamouroux) Mont. (1)  
*Cheilosporum sagittatum* (Lamouroux) Aresch. (1)  
*Jania* sp. (1)  
*Thamnoclonium* sp. (1)  
*Callophyllis* sp. (1)  
 \**Schottera nicaense* (Duby) Guiry & Hollenberg (1)  
*Glioderma* sp. (1)  
*Aglaothamnion* sp. (1)  
 \**Anotrichium crinitum* (Keutzing) Baldock (1)  
 \**Antithamnion pinnafolium* Wollaston (1)  
*Balliella* sp. (1)  
*Callithamnion* sp. (1)  
*Ceramium* sp. (3)  
 \**Mediothamnion* sp. (3)  
*Platythamnion* sp. (3)  
 \**Propagula* sp. (1)  
*Pleonosporium* sp. (1)  
*Spongoclonium* sp. (1)  
*Acrosorium decumbens* (J. Ag.) Kylin (1)  
*Phycodris* sp. (2)  
*Dasya wilsonis* J. Agardh (1)  
*Heterosiphonia australis* (J. Ag.) De Toni (1)  
*Aphanacladia* sp. (1)  
*Amplisiphonia* sp. (1)  
*Dasyclonium incisum* (J. Ag.) Kylin (1)  
*Polysiphonia* sp. (1)

## INVERTEBRATA

## Porifera:

- Callyspongiidae  
*Callyspongia* sp. (2)  
 Raspailiidae (3)  
 Suberitidae (3)  
 Spongiidae (2)

## Hydroida:

## Athecata:

- Tubularia australis* Stechow (1)  
*Eudendrium* sp. (1)

## Thecata:

- \**Clytia* sp. (1)  
*Obelia* sp. (3)  
*Hebella scandens* (Bale) (1)  
 \**Hebella* sp. (1)  
*Hincksella cylindrica* (Bale) (1)  
*Halecium sessile* Norman (1)  
 \**Halecium* ? *fragile* Hodgson (1)  
*Halecium delicatulum* Coughtrey (1)  
 \**Scoresbia daidala* Watson (2)

<i>Sertularella simplex</i> Coughtrey	(2)
* <i>Amphisbetia olseni</i> Watson	(1)
<i>Antennella secundaria</i> Gmelin	(3)
* <i>Antennella</i> sp. 2	(2)
* <i>Monostaechus quadridens</i> McGrady	(3)
<i>Plumularia spinulosa</i> Bale	(2)
<i>Plumularia obliqua</i> Saunders	(3)
* <i>Plumularia asymmetrica</i> Bale	(3)
Actinaria:	
<i>Anemone</i> sp.	1
Alcyonaria:	
<i>Capnella gaboensis</i> Verseveldt	(3)
Alcyonaria sp. 2	(1)
Alcyonaria sp. 3	(1)
Bryozoa:	
* <i>Aetea anguina</i> (Linnaeus)	(3)
<i>Chaperia cervicornis</i> (Busk)	(1)
<i>Caberea helicina</i> Hastings	(1)
* <i>Emma triangula</i> (Hastings)	(3)
* <i>Celleporaria intermedia</i> (MacGillivray)	(1)
<i>Celleporaria (Sinuaporaria ?) hastigera</i>	(1)
<i>Discopora vultur</i> (Hincks)	(1)
<i>Smittoidea acaroenis</i> (Busk)	(1)
<i>Celleporina</i> sp.	(3)
* <i>Crisia acropora</i> Busk	(3)
<i>Bicrisia edwardsiana</i> (d'Orbigny)	(1)
* <i>Pustulopora ? intricaria</i> (Busk)	(2)
"Retepora" sp.	(2)
<i>Scuticella ventricosa</i> (Busk)	(2)
<i>Amathia biseriata</i> Krauss	(1)
Polychaeta:	
<i>Ophiodromus</i> sp.	1
<i>Haplosyllis spongicola</i> Grube	2
<i>Pionosyllis</i> sp.	1
<i>Typosyllis</i> sp.	8
<i>Exogone</i> sp.	1
<i>Platynereis australis</i> (Schmarda)	1
* <i>Nematonereis unicornis</i> (Grube)	4
<i>Phyllochaetopterus socialis</i> Claparède	(3)
<i>Idanthyrus pennatus</i> (Peters)	1
<i>Branchiommma nigromaculata</i> (Baird)	2
<i>Hydroides ? brachycantha</i> Rioja	1
<i>Pomatostegus polytrema</i> (Philippi)	1
<i>Filograna implexa</i> Berkley	(1)
<i>Serpula vermicularis</i> Linnaeus	(2)
<i>Spirobranchus giganteus</i> (Pallas)	5
Sipunculida:	
Sipunculid sp.	1
Nemertina:	
Nemertine sp.	2
Brachiopoda:	
<i>Magellania flavescens</i> (Lamarck)	1
Gastropoda:	
<i>Torvamurex denudatus</i> (Perry)	11
<i>Dentimitrella lincolnensis</i> (Reeve)	1
<i>Cypraea</i> sp.	1
<i>Notosinister maculosa</i> (Hedley)	4
<i>Mitra carbonaria</i> Swainson	2
<i>Austrosassia parkinsoniana</i> (Perry)	3
<i>Vermicularia</i> sp.	2
<i>Murexsul brazieri</i> (Angas)	2



## Ophisthobranchia:

<i>Aplysia sydneyensis</i> Sowerby	1
* <i>Philine</i> sp.	1
* <i>Trapania</i> sp.	1

## Bivalvia:

<i>Dosinia</i> sp.	1
<i>Venerupis exotica</i> Lamarck	1
<i>Hiatella australis</i> (Lamarck)	3
<i>Diplodonta globulosa</i> A. Adams	1
<i>Marikellia solida</i> (Angas)	1
<i>Cardita calyculata</i> (Linnaeus)	4
<i>Atrina tasmanica</i> (Tenison Woods)	2
<i>Lanistina impacta</i> (Hermann)	1
<i>Lima nimbifer</i> Iredale	4
<i>Trichomya hirsuta</i> (Lamarck)	7

## Crustacea:

## Amphipoda:

<i>Photis</i> sp.	3
<i>Aora</i> sp.	2
<i>Gammaropsis</i> sp.	1
Amphithoid sp. 1	1
Amphithoid sp. 2	1
<i>Cerapus</i> sp.	4
*Phlianthid sp.	1
* <i>Liljeborgia</i> sp.	2
<i>Mallacoota subcarinata</i> (Haswell)	6
<i>Tethygeneia</i> cf. <i>elanora</i> Barnard	1
? Corophiid sp.	4
<i>Amaryllis macrophthalmus</i> (Haswell)	1

## Tanaidacea:

<i>Paratanais</i> cf. <i>ignotus</i> (Chilton)	1
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## Isopoda:

<i>Cymodoce aspersa</i> (Haswell)	2
*cf. <i>Cymodoce</i> sp.	1
<i>Cilicaeopsis granulata</i> (Whitelegge)	1

## Brachyura:

<i>Plagusia chabrus</i> (Linnaeus)	1
<i>Halicarcinus ovatus</i> Stimpson	2
<i>Micippa tuberculosa</i> (H. Milne Edwards)	1
<i>Leptomithrax sternocostulatus</i> (H. Milne Edwards)	3

## Anomura:

<i>Paguristes sulcatus</i> Baker	1
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## Cirripedia:

<i>Balanus trigonus</i> Darwin	4
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## Pycnogonida:

<i>Achelia</i> sp.	2
<i>Nymphon molleria</i>	1

## Echinodermata:

## Ophiuroidea:

<i>Ophiotrix caespitosa</i> Lyman	13
* <i>Pholiostigma watsonae</i> (Baker m.s.)	2
* <i>Ophiacantha alternata</i> A. M. Clark	1
<i>Ophiactis resiliens</i> Lyman	1

## Holothuroidea:

<i>Pentacta doliolum</i> (Pallas)	1
* <i>Neocucumis ? watasei</i> (Ohshima)	1
* <i>Thyone</i> sp.	1

## Ascidiacea:

<i>Polycarpa pedata</i> Herdman	1
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## PISCES

## Gobiosocidae

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